CLAIMS

1. A controller for controlling an array antenna, said array antenna comprising:

a radiating element for receiving a transmitted radio signal;

a plurality of parasitic elements each provided to be distant from said radiating element at a predetermined interval; and

a plurality of variable reactance elements connected to said parasitic elements, respectively,

wherein said controller changes reactances to be set to said variable reactance elements, respectively, so that said parasitic elements operate as waveguides or reflectors, thereby changing a directivity characteristic of the array antenna,

wherein said controller comprising:

a control device for selecting one reactance set from among a plurality of reactance sets in a plurality of cases of setting the plurality of reactance sets, respectively so as to be able to obtain a diversity gain equal to or larger than a predetermined value, based on the radio signal received by said array antenna, based on a signal quality of the radio signal received in each of the plurality of cases according to a predetermined selection criterion, and for setting the selected reactance set to the plurality of variable reactance elements, respectively.

2. The array antenna controller as claimed in claim 1,

wherein the plurality of cases are of setting the plurality of reactance sets so as to be able to obtain a diversity gain equal to or larger than a predetermined value, and so as to keep an input

impedance of said array antenna substantially unchanged, based on the radio signal received by said array antenna.

3. The array antenna controller as claimed in claim 1 or 2,

wherein the signal quality of the radio signal is estimated using one of a signal strength, a signal power, a signal-to-noise ratio, a ratio of signal to noise including an interference noise, a ratio of a carrier signal to noise, a bit error rate, a frame error rate, and a packet error rate.

4. The array antenna controller as claimed in any one of claims 1 to 3,

wherein the selection criterion is such that the signal quality of the radio signal received in each of the plurality of cases is equal to or larger than a predetermined threshold.

5. The array antenna controller as claimed in any one of claims 1 to 3,

wherein the selection criterion is such that, when the signal quality of the radio signal received in each of a plurality of cases is one of a signal power, a signal-to-noise ratio, a ratio of signal to noise including an interference noise, and a ratio of carrier signal to noise, then a reactance set, as obtained when the signal quality is a maximum, is selected.

6. The array antenna controller as claimed in any one of claims 1 to 3,

wherein the selection criterion is such that, when the signal quality of the radio signal received in each of the plurality of cases is

one of the bit error rate, the frame error rate, and the packet error rate, then a reactance set, as obtained when the signal quality is a minimum, is selected.

7. The array antenna controller as claimed in any one of claims 1 to 6,

wherein the control device arbitrarily selects one reactance set from among the plurality of reactance sets when the signal quality of the radio signal received in each of the plurality of cases is smaller than a predetermined threshold, and repeats the selection processing until the signal quality reaches a predetermined selection criterion for the selected reactance set.

8. The array antenna controller as claimed in any one of claims 1 to 6,

wherein said control device selects one reactance set in a predetermined order from among the plurality of reactance sets when the signal quality of the radio signal received in each of the plurality of cases is smaller than a predetermined threshold, and repeats the selection processing until the signal quality reaches a predetermined selection criterion for the selected reactance set.

9. The array antenna controller as claimed in any one of claims 1 to 8,

wherein said control device switches over the plurality of cases with changing a threshold in a predetermined range, and sets as said threshold, a threshold as obtained when the signal quality of the radio signal satisfies a predetermined selection criterion.

10. The array antenna controller as claimed in any one of claims 1 to 9,

wherein said array antenna comprises an even number of parasitic elements and an even number of variable reactance elements,

wherein the even number of parasitic elements includes at least one first set of parasitic elements and at least one second set of parasitic elements,

wherein the even number of variable reactance elements include a first set of variable reactance elements connected to the first set of parasitic elements, respectively, and a second set of variable reactance elements connected to the second set of parasitic elements, respectively,

wherein the plurality of cases include a first case in which the first reactance set is set to the first and second sets of variable reactance elements, and a second case in which the second reactance set is set to the first and second sets of variable reactance elements, and

wherein said control device selects one reactance set based on the signal quality of the radio signal received in each of the first and second cases, and sets the selected reactance set to the first and second sets of variable reactance elements.

11. The array antenna controller as claimed in any one of claims 10,

wherein said array antenna comprises first and second parasitic elements, the first reactance set includes reactances X_a and X_b which are set to said first and second parasitic elements, and said second

reactance set includes the reactances X_b and X_a which are set to said first and second parasitic elements.

12. The array antenna controller as claimed in any one of claims 1 to 9,

wherein said array antenna comprises a plurality of parasitic elements each being distant from said radiating element at a predetermined interval, and the parasitic elements are provided at substantially equal angle relative to each other, and

wherein the plurality of cases include a case in which a plurality of reactance sets obtained by circulating respective reactances are set so as to be able to obtain a diversity gain equal to or larger than a predetermined value, based on the radio signal received by said array antenna.

13. The array antenna controller as claimed in any one of claims 1 to 9,

wherein said array antenna includes a plurality of parasitic elements each being distant from said radiating element at a predetermined interval, and the parasitic elements are provided at substantially equal angle relative to each other, and

wherein the plurality of cases include a case in which a plurality of reactance sets obtained by circulating respective reactances are set so as to be able to obtain a diversity gain equal to or larger than a predetermined value and so as to keep the input impedance of said array antenna substantially unchanged, based on the radio signal received by said array antenna.

14. The array antenna controller as claimed in any one of claims 1 to 9,

wherein said array antenna comprises:

at least one pair of parasitic elements provided linearly symmetrically about a symmetric line that serves as a symmetric axis, and that passes through a position of said radiating element; and

a plurality of parasitic elements provided either one of to be located on the symmetric line and to be linearly symmetric about the symmetric line serving as the symmetric axis, and

wherein the plurality of cases include at least two cases in which a plurality of reactance sets obtained by replacing reactances of at least one pair of parasitic elements provided linearly symmetrically with each other are set so as to be able to obtain a diversity gain equal to or larger than a predetermined value, based on the radio signal received by said array antenna.

15. The array antenna controller as claimed in any one of claims 1 to 9,

wherein said array antenna comprises:

at least one pair of parasitic elements provided linearly symmetrically about a symmetric line that serves as a symmetric axis, and that passes through a position of said radiating element; and

a plurality of parasitic elements provided either one of to be located on the symmetric line and to be linearly symmetric about the symmetric line serving as the symmetric axis, and

wherein the plurality of cases include at least two cases in which

a plurality of reactance sets obtained by replacing reactances of at least one pair of parasitic elements provided linearly symmetrically with each other are set so as to be able to obtain a diversity gain equal to or larger than a predetermined value, and so as to keep the input impedance of said array antenna substantially unchanged, based on the radio signal received by said array antenna.

16. The array antenna controller as claimed in any one of claims 1 to 15,

wherein when a CDF, which is a cumulative probability of such an event as a signal power of the received radio signal exceeding a predetermined signal power, is a predetermined value, the plurality of reactance sets are set so that the diversity gain is substantially a maximum.

17. The array antenna controller as claimed in any one of claims 1 to 15,

wherein when a CDF, which is a cumulative probability of such an event as a signal power of the received radio signal exceeding a predetermined signal power, is a predetermined value, the plurality of reactance sets are set so that the diversity gain is equal to or larger than a predetermined value.

18. The array antenna controller as claimed in any one of claims 1 to 13,

wherein said array antenna comprises:

one radiating element; and

two parasitic elements between which said radiating element is

provided, and which are provided linearly together with said radiating element.

19. The array antenna controller as claimed in claim 18, wherein a distance between said radiating element and each of said parasitic elements is set to one of lengths which are 0.1 to 0.35 times as large as a wavelength of the received radio signal.

20. The array antenna controller as claimed in claim 18 or 19, wherein said array antenna comprises:

a dielectric substrate including first and second surfaces parallel to each other;

a grounding electrical conductor formed on a predetermined first region on the second surface of said dielectric substrate; and

three strip electrical conductors formed on the first surface of said dielectric substrate, said three strip electrical conductors being formed to have a predetermined length so as to protrude from a region opposite to the first region, and to be provided at predetermined interval, said three strip electrical conductors operating as the radiating element and the two parasitic elements, respectively.

21. An array antenna apparatus comprising:

one radiating element;

two parasitic elements between which said radiating element is provided, and said two parasitic elements being provided linearly together with the radiating element; and

two variable reactance elements connected to said parasitic elements, respectively,

wherein said array antenna apparatus changes reactances which are set to said respective variable reactance elements, so that the parasitic elements operate as waveguides or reflectors, thereby changing a directivity characteristic of said array antenna apparatus,

wherein said array antenna apparatus further comprises:

a dielectric substrate including first and second surface parallel to each other;

a grounding electrical conductor formed on a predetermined first region on the second surface of said dielectric substrate; and

three strip electrical conductors formed on the first surface of said dielectric substrate, said three strip electrical conductors being formed to have a predetermined length so as to protrude from a region opposite to the first region, and said three strip electrical conductors being provided at a predetermined interval, and operating as the radiating element and the two parasitic elements, respectively.

22. The array antenna apparatus as claimed in claim 21,

wherein a distance between the radiating element and each of the parasitic elements is set to one of lengths which are 0.1 to 0.35 times as large as a wavelength of a received radio signal.